COLUMBIA RADIATION LABORATORY
DEPARTMENT OF PHYSICS
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NEW YORK, NEW YORK 10027

Semi-Annual Report Number 2
to the
National Aeronautics and Space Administration
for
Grant NsG-445 (Scope B)
33-008-012

Entitled

X-RAY ASTRONOMY

a) Period: 1 February 1967 to 31 July 1967

b) Personnel:

R. Novick, Principal Investigator
P. Vanden Bout, Research Associate in Physics
F. W. Kantor, Graduate Research Assistant
T. E. Wing, Graduate Research Assistant

July 1967

c) Degrees Awarded: None

d) Papers Presented at Scientific Meetings:

F. W. Kantor, R. Novick, and T. E. Wing, "Self-Aligning Inflatable Counter Suitable for Large-Area Self-Erecting Arrays in Space," American Physical Society Meeting, Washington, D. C., April 24-27, 1967, Bull. Am. Phys. Soc. 12, 592 (1967).

F. W. Kantor, R. Novick, and T. E. Wing, "A Large-Area Modular X-Ray Focusing System," Polytechnic Institute of Brooklyn Symposium on Modern Optics, New York, N. Y., March 22-24, 1967.

e) Reports:

Columbia Radiation Laboratory Progress Report No. 15, November 1, 1966 - April 30, 1967, pp. 87-99.

f) Description of Research:

Work in the period covered by this report has been concentrated in three areas: 1) A prototype polarimeter, capable of being flown in space, has been built; 2) a flight version of the x-ray collector has been constructed; and 3) laboratory test facilities have been provided.

The prototype polarimeter, which utilizes the polarization sensitivity of the angular dependence of Compton scattering, will be flown in a balloon to an altitude of 120,000 ft to check the background characteristics of the instrument. A method was developed for cold-forming the lithium scattering material into blocks. The lithium is kept from oxidizing by wrapping it with Saran. The counters, which are filled with a gas mixture of 90% xenon and 10% methane at 3 atm pressure, are used to detect the scattered x rays and are surrounded by an anticoincidence plastic shield. In addition, events are rejected in which two counters fire simultaneously. A small on-board computer has been built to provide the anticoincidence circuitry and to provide background diagnostic information. Analysis of data from this balloon flight will make it possible to choose the best method of background suppression. The flight will also determine the level of background which cannot be suppressed, thus fixing the sensitivity of the instrument.

The x-ray collector utilizes a large number of thin-glass plates arranged in rings to reflect x rays at grazing incidence to a common point. A collector has been built with a focal length of about 50 inches, which is capable of being flown in an Aerobee sounding rocket. The geometric collecting area is about 250 cm^2, and x rays are focused with an efficiency of 30% for an energy of 1.5 keV and with higher efficiencies for lower energies. Work was begun for the development of suitable thin-window counters to

detect the x rays focused by the collector. Calculations indicate that the over-all collector-detector assembly will have a relatively flat response, being 20% efficient for x rays of wavelengths 8 to 28 Å. This instrument will be flown to locate extragalactic sources of x rays. In particular, the region near M-87 and 3C273 will be observed. The angular precision with which sources can be located depends on the intensity of the source, but is roughly 1/2 degree. This resolution will be increased by using a matrix of detectors in the focal plane of the detector. Thus, the statistics can be improved by following the path of an x-ray source in the focal plane.

In the construction of laboratory test facilities, an evacuated tube 40 meters long has been built which will accommodate an Aerobee pay-load at one end. A small x-ray source at the other end then provides a beam of x rays at the pay-load that is diverging by less than 1/2 degree. This enables us to check the angular response and sensitivity of instruments with a stellar-like source. A vacuum spectrograph has been obtained for making measurements of the transmissivity and reflectivity of various materials for x rays. This facility will provide calibrations of counter windows and x-ray filters. A Henke x-ray tube has also been obtained for use as an intense source of low-energy continuum or fluorescence x rays with either the vacuum spectrograph or the long, evacuated tube.